

Baker Hughes 

Cementing services

[bakerhughes.com](https://www.bakerhughes.com)



Zonal isolation suite

By collaborating closely with operators and drawing from a comprehensive portfolio of design processes, cementing technologies and equipment, and leveraging experienced field personnel, Baker Hughes helps minimize risks and ensure long-term integrity for wells around the world.

Combining well simulation, cementing, evaluation, and mechanical barrier technologies under one comprehensive well integrity solution lets Baker Hughes better address various well integrity challenges by deploying the optimal combination of advanced technologies and principles of flawless execution.

Laboratory qualifications

- Standard API Tests
- HP/HT tensiometer, wettability apparatus, expansion and shrinkage, shear strength, and self-sealing

Job design tools

CemMaster™ cementing software suite, including:

- Interactive cement hydraulics and mud removal simulator
- Circulating temperature modeling
- Precision displacement efficiency simulator
- Cement stress analysis for the life of the well
- Plug cementing design
- In-pipe mixing analysis
- Gas/fluid migration risk analyzer
- Pump quality index analysis

Effective mud removal

- SealBond™ Ultra cement spacer system
- MultiBond™ spacer system
- UltraBond™ spacer system
- XtremeBond™ cement spacer system
- UltraFlush™ spacer system

Set for Life™ cement systems

- LiteSet™ lightweight cementing system
- DuraSet™ flexible cementing system
- PermaSet™ cement slurries
- FoamSet™ foam cementing system
- DeepSet™ deepwater cementing system
- EnsuroSet™ self-healing cement systems
- FireSet™ in-situ combustion cement system
- XtremeSet™ HPHT cement systems

Service delivery

- Flawless execution
- Reliability and competency
- Seahawk™ and Hawk™ cement units

Job evaluation

- Post-job analysis
- Logging technologies (SBT)
- CemIntegrity™ solution for long-term zonal isolation

Offering a complete cementing solution

The cement sheath that seals your wellbore is, ultimately, an investment to ensure safe, secure well operations and a protected environment.

Baker Hughes helps minimize risks and confirm long-term integrity for wells around the world by collaborating closely with operators; drawing from a comprehensive portfolio of design processes and tools, cementing technologies, and equipment; and leveraging experienced field personnel.

The result: precise slurries matched to well conditions that deliver the well integrity you need while minimizing nonproductive time.

Success through planning and simulation

A good cement job starts with a proper understanding of the well design, the risks, and cementing best practices. These practices—including mud conditioning, optimal pump rates, optimum densities, centralization, and other factors that ensure effective mud removal—are critical elements for long-term zonal isolation. Through close collaboration with you, we ensure that we fully understand all of the challenges and have all the critical data needed to perform the job.

Our CemMaster advanced cement placement software incorporates the planned cement setting depth, hole size, desired pump rates, and bottomhole temperatures and pressures to simulate cement slurry placement. It also performs interactive calculations of the necessary slurry and spacer volumes, mixing and displacement rates, and anticipated pressures. The simulation factors in fluid compressibility, pipe movement, buoyancy, eccentric annulus, and accommodates multiple temperature regimes.

This allows us to accurately predict downhole density changes, to model more realistic equivalent circulating densities, and when necessary, to modify pump rates to avoid lost circulation or fluids migration.

The software also models the radial and tangential stresses on the set cement and determines whether the planned sheath will perform effectively over the full life of the well. When needed, our experts can modify the cementing program to adjust the cement's compressive and tensile strength, Young's modulus, and Poisson's ratio, and make the cement more resilient to downhole stresses.

The CemMaster software's 3D precision displacement feature provides Baker Hughes engineers with a better understanding of fluid contamination risks. The combined benefits of these simulation tools go beyond the ability to make changes to the cement job design. They help our engineers make informed decisions regarding the stage placement, slurry design, and cement system selection—minimizing risk throughout the well's life.







Preparing the well for a solid bond

Once the simulation is completed and the cementing operation begins, Baker Hughes provides an optimal spacer program to ensure that the wellbore is free of drilling mud and other debris. We also water-wet the casing string and formation rock for reliable cement bonding.

An optimal spacer system ensures that the cement is properly placed, reduces lost circulation risks, and helps avoid damage to the producing formations. Baker Hughes offers a variety of systems so that, regardless of the situation, we can apply the appropriate solution to best match the drilling fluid and specific well conditions. These spacer systems include:

- The **UltraBond spacer system** effectively displaces the drilling fluid in the annulus, improves fluid compatibilities, optimizes displacement efficiencies, provides superior cement bonding, and promotes effective mud removal.
- The **MultiBond spacer system** helps recover expensive nonaqueous fluid drilling fluids while preparing the well for a cement job.
- The **SealBond cement spacer system** mitigates lost circulation issues by reducing slurry fallback after placement, preventing induced losses and eliminating costly remedial cement jobs.
- The **XtremeBond cement spacer system** provides optimum mud removal in high-pressure and high-temperature wells for superior cement bonding.



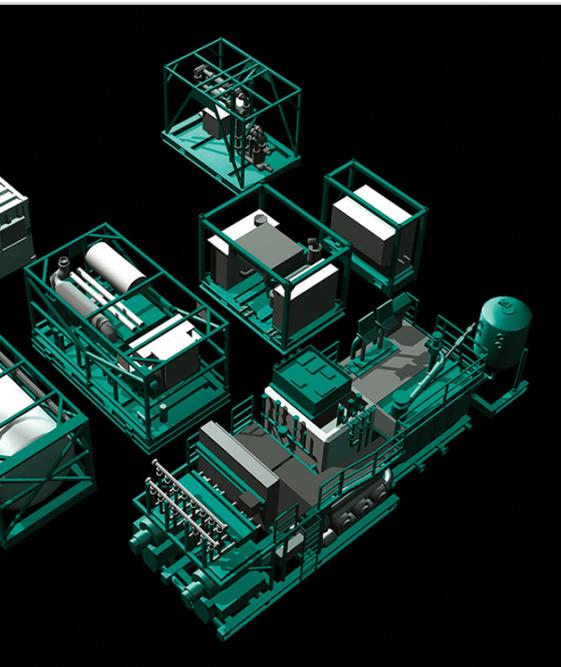
Providing zonal isolation that's set for life

Once the wellbore has been properly conditioned, a cement slurry is chosen that is most suitable for the known well conditions and anticipated challenges, in order to ensure long-term isolation.

Baker Hughes has a wide variety of cementing offerings under the **Set for Life family of cement systems** that can be customized to address a host of downhole conditions and well requirements—providing the solution appropriate for the life of the well. These solutions include:

- The **DeepSet system controls** shallow water and gas flow in deepwater wells safely and effectively.
- The **DuraSet system** withstands stresses induced by hydraulic fracturing, high injection pressures, and temperature fluctuations.

- The **FoamSet system** lowers lost-circulation risks, protects against shallow gas flows, and improves hole cleaning; this system also offers several logistical advantages in wells where bulk cement storage space is at a premium.
- The **LiteSet system** delivers superior-quality lightweight cements with high compressive strengths.
- The **PermaSet system** provides maximized cement longevity in carbon-dioxide environments and other corrosive environments.
- The **XtremeSet system** ensures long-term zonal isolation in wells with bottomhole temperatures as high as 600°F (316°C) and pressures up to 40,000 psi (275.8 MPa).
- The **FireSet™ system** is suitable for placing across underground coal gasification or fireflood well operations.
- **Ensuset™ system** is a durable and resilient cement that will seal cracks when in contact with liquid hydrocarbons and/or condensates.





Delivering flawless execution in the field

Baker Hughes is committed to providing world-class engineering; consistent and high-quality cement products and additives; well-trained personnel; and high-performance equipment to ensure dependable, long-term cement performance in every well, every time.

Our specialized cementing equipment—including the **Hawk land-based units** and the **Seahawk units**—supports flawless wellsite operations reliably, safely, and cost-effectively.

Run by well-trained personnel, this equipment includes fully automated slurry density control—a robust process that allows high-rate, heavyweight, and ultralightweight mixing while providing ergonomic safety for the cement unit operator and critical component redundancy.

Confirming cement quality

State-of-the-art lab capabilities support the engineered design of fluids. Once the cement job has been

completed, we evaluate the results using our CemMaster software. The software highlights any deviations between the simulation and reality, enabling us to confirm that the job objective was met and to continuously improve the cement job design for future wells, further optimizing the zonal isolation process.

Baker Hughes also provides cement evaluation tools to verify zonal isolation between zones by measuring the bond between the casing and the cement pumped into the wellbore annulus.

These cement bond logs help confirm that the cementing program meets your desired objectives and delivers the proper zonal isolation.

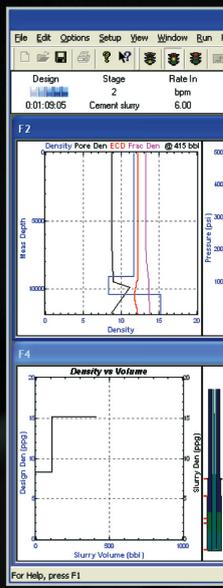
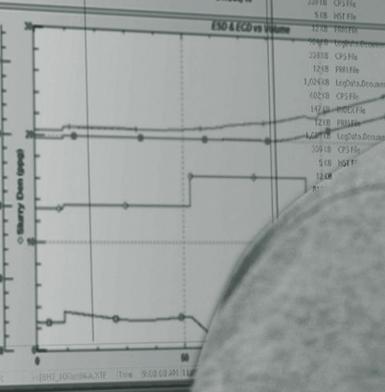
To further protect your investment, we can provide regular inspection of the production tubing and casing. This permits early detection of problem areas and allows for timely planning of remedial action before any potential issues impact zonal isolation or well integrity.



CAUTION: USE ONLY
SHELL RETINAX LX2
GREASE

Baker Hughes 

Baker Hughes 



Key technologies

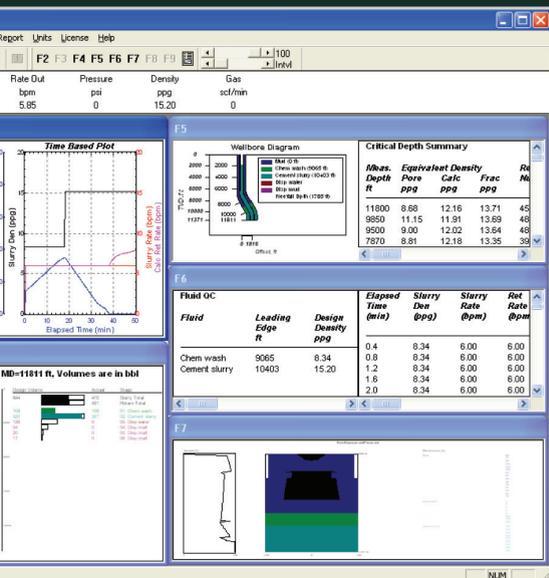
CemMaster cementing software

The CemMaster software application is a primary and remedial cement design system that provides pre-job design, real-time simulation, and post-job analysis. This application enables interactive data entry, graphical simulation, and text and graphics reporting capabilities.

The software monitors and analyzes multiple muds, spacers, cements, and displacement fluids, as well as pump rates and shutdowns. Trained Baker Hughes personnel use this software to improve quality control and analysis of cementing operations. It performs interactive calculations of volumes and quantities of cement, water, nitrogen, and additives to enable the operator to modify rates and avoid lost circulation or fluids

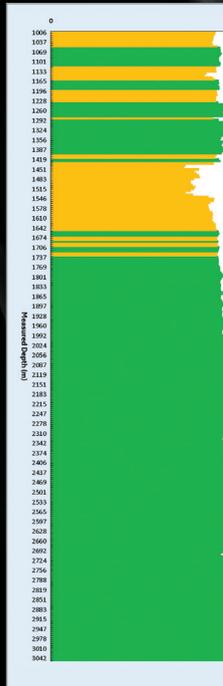
migration while maintaining desired flow regime.

- Displays comprehensive wellbore geometry
- Includes user-definable centralizer, fluid, and tubular databases
- Simultaneously models Newtonian, Power Law, Bingham Plastic, and Herschel-Bulkley fluid flow
- Calculates and graphically displays flow regime and pressure drop calculations
- Incorporates temperature-based rheology calculations
- Models fluid compressibility and foamed fluids
- Provides fluid leak-off modeling option
- Provides forward-and reverse-circulation modes
- Models freefall effects
- Integrates centralizer spacing and drag/torque calculations
- Calculates pipe eccentricity and fluid displacement/placement
- Calculates pressures at surface, bottom, and critical depths using hydraulic simulator
- Shares data between analysis models
- Models pipe movement and buoyancy effects
- Takes into account eccentric annulus effect on ECD





Education Center



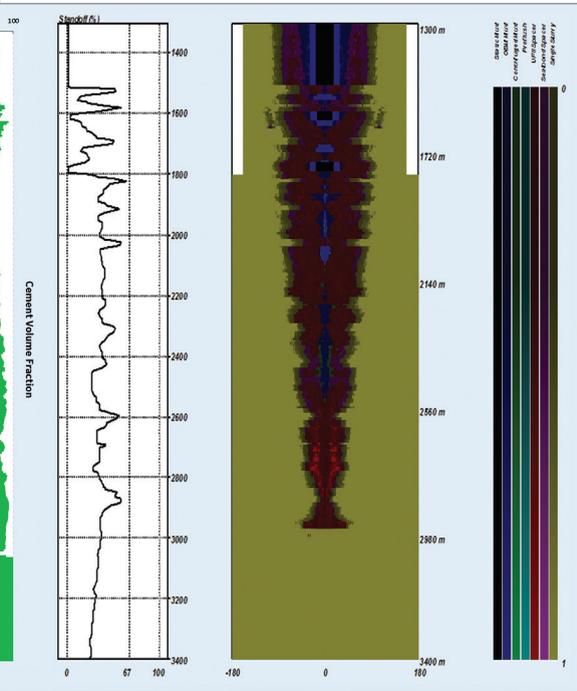
CemMaster cement placement software application

Understanding mud removal and cement placement is a key factor to ensuring zonal isolation. It is important in achieving wellbore integrity to identify both the expected top of circumferential cement coverage and any possible risks of inter-zonal communication due to low displacement efficiencies. Proper understanding mitigates risks of poor zonal isolation results which can lead to costly workovers to repair the cement job and lost production due to poor cement isolation.

This software application helps to ensure zonal isolation in the well by using finite difference numerical solutions to accurately depict the degree of contamination

(intermixing) of fluids and decay of cementing fluids.

CemMaster software provides extremely accurate mud removal efficiency prediction. In fact, it recently displaced a competitor's software as one major operator's choice for cement simulation. This allowed the operator to greatly reduce the requirement for running expensive and time consuming cement bond logs due to its high degree of accuracy.



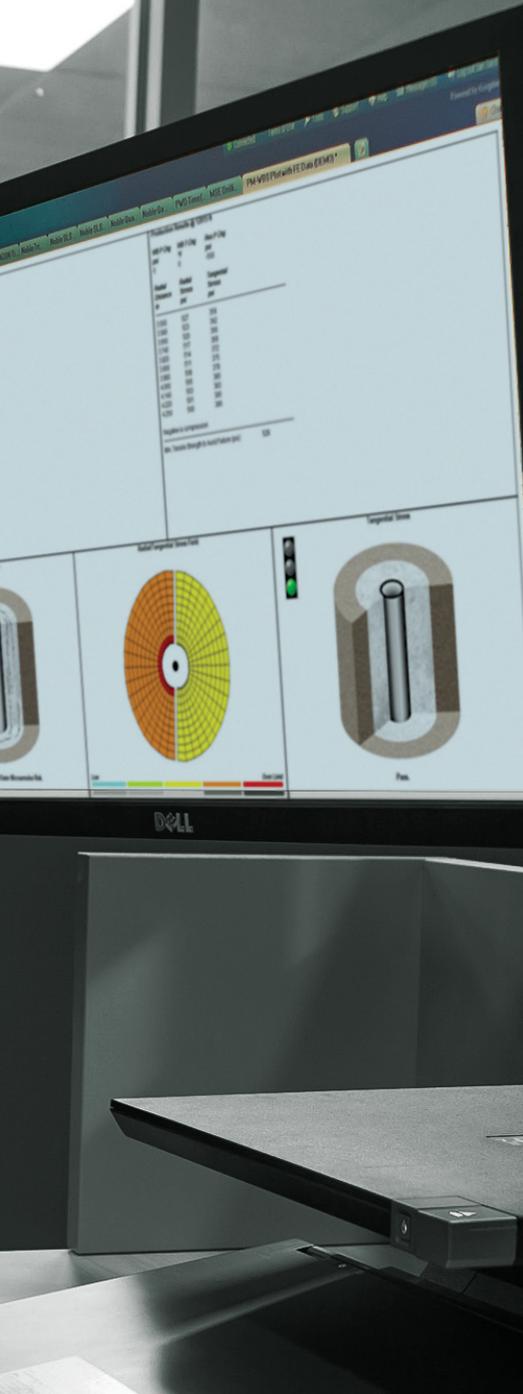


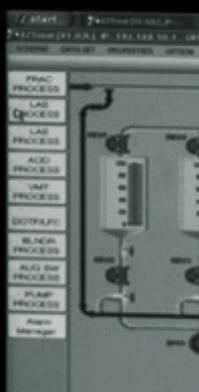
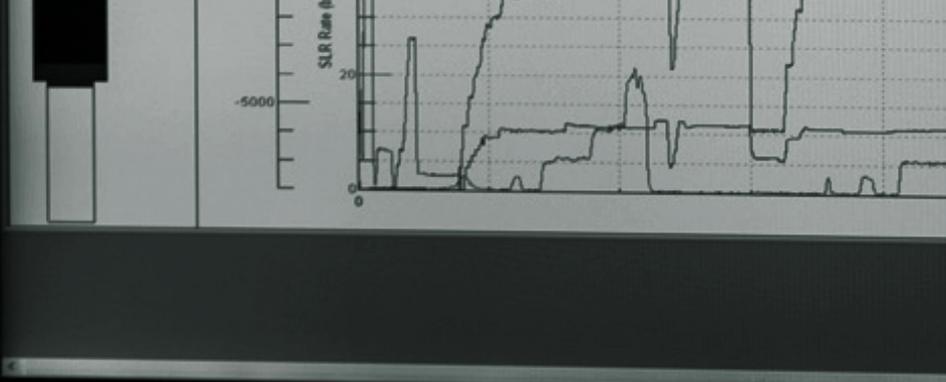
CemMaster cement stress analysis software

The CemMaster cement stress analysis software module calculates and then numerically and graphically displays radial and tangential stresses acting on the cement due to stresses caused by changes in wellbore temperature, wellbore pressure, or reservoir pressure.

The user inputs the physical properties of the casing, cement, and formation as well as any expected changes to temperatures or pressures that may be encountered during the cementing, fracturing, or production phases of the well.

- Models and displays cement stresses resulting from changes in the reservoir or near-wellbore environment
- Offers simplified use with a clean, concise interface





Pump Quality Board V0.1B1

Cement

Job Information

Customer: [Redacted]

Well Name: [Redacted]

Service Type: 22" Foam Job

Service Date: 9-12-15

Pump Unit: [Redacted]

PGI Trend Post Service Check Point

Scale Adjustment	From	To
Elapsed Time Scale	0	1
Density / Rate Scale	0	1
Pressure Scale	0	1

Slurry	Target Density	Average Density	Density
Slurry 1	0.0	0.0	
Slurry 2	15.4	14.5	

Target Density Actual Density

Density

Rate

99.4

CemMaster pump quality index software

Maintaining designed cement slurry density while mixing the job is a critical performance parameter in oil well cementing. All slurry properties are directly related to the designed density. Not only can a deviation from the designed density compromise the quality of the cement job, it could also result in catastrophic well failure.

The Pump Quality Index (PQI) is a numerical, unbiased performance evaluation tool easily incorporated into post-job analysis and/or post-well reports. The objective of the analysis is to score pump and operator performance within expected cement slurry mixing parameters, primarily density and rate.

The CemMaster PQI software module moves job performance evaluation to the digital level. The PQI score can be set as a KPI to establish a baseline against which cementing performance can be evaluated. This information is beneficial for customers and Baker Hughes in order to effectively evaluate our operations and identify potential improvements for future operations.

- Reflects pump and operator performance, supporting quick identification and correction of pump or operator efficiency
- Generates reports and performance trends of different cementing jobs
- Visibility as a Key Performance Indicator (KPI) component
- Provides immediate performance feedback to customers





SealBond Ultra cement spacer system

The SealBond cement spacer family has been mitigating lost circulation issues while cementing since 2007. Our recently-developed SealBond Ultra system now allows us to go even further with the ability to seal natural fractures with diameters up to 4mm. It can minimize filtrate invasion and damage as well as induced losses. Based on its ultralow invasion fluid technology, this system forms a barrier at the wellbore wall to strengthen the wellbore. The formation can retain its integrity and permeability for optimized production because of the near 100% return permeability property of the spacer.

SealBond spacers reduce slurry fallback after placement to prevent lower-than-expected cement tops and eliminate costly remedial cement jobs. In wells with critical fracture gradients, the Baker Hughes cement spacer technology helps to strengthen the wellbore, allowing the equivalent circulating density (ECD) to be exceeded without losses. This eliminates the need to compromise on thickening times and compressive strength and, in some cases, eliminate the use of a stage collar.

The SealBond cement spacer system can be used in high-temperature, high-permeability formations;

formations with low fracture gradients; and fragile, unconsolidated, and fractured formations.

- Effectively reduces cement losses and formation damage from filtrate migration
- Able to seal natural fractures up to 4mm
- Prevents cement fallback after placement, providing predictable and effective isolation
- Allows increased ECD at casing depth in wells where the fracture gradient limits the design density of the cement
- Forms a seal to minimize filtrate invasion into the formation
- Enhances hole cleaning before cement placement, effectively removing gelled drilling fluid by optimizing flow regime, density, and chemical enhancement
- Provides wellbore strengthening and reduces incidents of induced losses
- Compatible with virtually all cement systems and drilling fluids
- Poses little or no risk to the environment (certified as OSPAR PLONOR)



MultiBond spacer system

The MultiBond spacer promotes effective mud removal, along with hydraulic and shear cement bonds for an improved zonal isolation.

This new spacer fluid is engineered with suspension characteristics that significantly reduce settling, which is especially important for highly deviated and horizontal wells. Its rheological properties can be modified to deliver appropriate plastic viscosity and yield point depending on well conditions. Fluid densities can be adjusted so that a combined friction pressure and density hierarchy can be maintained throughout the job.

- Provides economical solution to recovery of non-aqueous drilling fluids
- Offers superior suspension characteristics for improved stability
- Improves economics when pumping large volumes for maximum wellbore cleanup





UltraBond spacer system

The UltraBond spacer system is a water-based spacer designed to effectively displace the drilling fluid in the annulus, improve fluids compatibilities, optimize displacement efficiencies, provide superior cement bonding, and promote effective mud removal. It can be used with a wide range of non-aqueous drilling fluids by being compatible with different surfactant packages.

- Improves fluids capabilities
- Provides optimum friction pressure hierarchy
- Offers customizable rheology
- Ensures environmental compliance as a SmartCare™ qualified product



UltraFlush ME spacer system

The UltraFlush microemulsion (ME) spacer system provides maximum wellbore cleaning for oil- or synthetic-based mud systems. This patent-pending technology is revolutionizing the cleanup of oil-based fluids in the wellbore. It enhances the overall cementing job quality by improving displacement efficiency, providing better wellbore fluid compatibility, and water-wetting the casing and formation for superior bonding.

The UltraFlush ME spacer system can be customized according to the base oil to obtain the proper balance of surfactant, oil, and water, so that the oil phase in situ is broken down into nanoparticle-sized droplets that provide a strong emulsion. The UltraFlush spacer system can be easily modified with additional gellants to adjust viscosity.

- Ensures superior wellbore cleanup for oil- or synthetic-based mud
- Permits customizable solutions based on mud type
- Provides optimum friction pressure hierarchy



LiteSet lightweight cement system

The LiteSet premium cement system uses nitrogen or air to foam base slurry to a lightweight density to produce a high-strength cement system. A second option uses lightweight, high-strength spheres to create a low-density, high-strength cement system.

Once the optimum balance of cement, spheres, and water are in the base design for desired density, other additives can be used to develop slurry properties to satisfy well parameters. LiteSet cement systems are used in primary cementing operations requiring premium lightweight cement systems as well as shallow water flow and gas migration environments.

We solve potential problems at the wellhead and understand that a single slurry does not fit all applications. This approach enables unlimited design flexibility. Our cementing process uses state-of-the-art cement pumping equipment, such as the Seahawk and Hawk cement units, to help ensure a quality cement job.

- Provides superior quality lightweight cements with higher compressive strengths than conventional extended slurries
- Part of the Baker Hughes Set for Life family of cement systems, which are designed to isolate and protect the targeted zone for the life of the well
- Real-time well conditions determine the final slurry composition



DuraSet cement system

The DuraSet cement system is specifically designed to provide improved tensile strength and elastic properties while exhibiting enhanced mechanical properties. The use of specific additive combinations and, in some cases, foam offers improved flexural and tensile strength, elastic properties, and fracture toughness. DuraSet slurries can be used in the majority of casing or liner applications.

Baker Hughes solves potential problems at the wellhead, understanding that a single slurry does not fit all applications. This approach enables unlimited design flexibility and takes elastic cement systems out of the lab and into the real world.

- Real-time well conditions both before and after cementing determine the final slurry composition
- DuraSet cement slurries are part of the Set for Life family of cement systems, which are designed to isolate and protect the targeted zone for the life of the well
- Compatible with virtually all API and ASTM cements and most Baker Hughes cement additives





PermaSet cement system

The PermaSet slurries are fit-for-purpose, corrosion-resistant cement systems designed primarily for carbon dioxide (CO₂) and hydrogen sulfide (H₂S) environments. They are used in primary and remedial cementing operations. They are compatible with most Baker Hughes additives and can be designed for use in virtually any well condition anywhere in the world.

PermaSet cement slurries are part of the Baker Hughes Set for Life family of cement systems that isolate and protect the targeted zone for the life of the well. These slurries can be blended with other systems in this family to help ensure long-term zonal isolation.

Baker Hughes solves cementing problems at the wellhead by taking CO₂- and H₂S-resistant cement systems out of the laboratory and into the real world.

- Improves the cement's resistance to attacks from CO₂, H₂S, magnesium, sulfate, and other corrosive fluids
- Eliminates weak points and reduces carbonation with negligible Portlandite content
- Delivers cement with lower permeability than conventional systems
- Reduces shrinkage and cracking with a lower heat evolution during setting
- Provides good mechanical properties
- Uses real-time well conditions to determine the final slurry composition
- Is compatible with virtually all API and ASTM cements and most Baker Hughes cement additives



CAUTION DO NOT STRIKE
PRESSURE VESSEL WITH
METAL HAMMER

FoamSet foam cementing system

The FoamSet cementing system is designed to provide wellbore integrity and ensure proper zonal isolation in both onshore and offshore horizontal and extended-reach wells.

The versatile, all-liquid FoamSet system saves time and money by mitigating lost circulation as well as shallow water/gas flows. The system also improves fluid displacement efficiencies as compared to conventional cements.

- Minimizes lost circulation risks by reducing hydrostatic pressure—lowering the risk of formation breakdown
- Protects against shallow gas flows by maintaining a more constant pressure to keep the water or gas in the formation and out of the annulus
- Improves hole cleaning by providing a more viscous fluid to scour and remove any immobile mud from the annulus
- Reduces storage space requirements



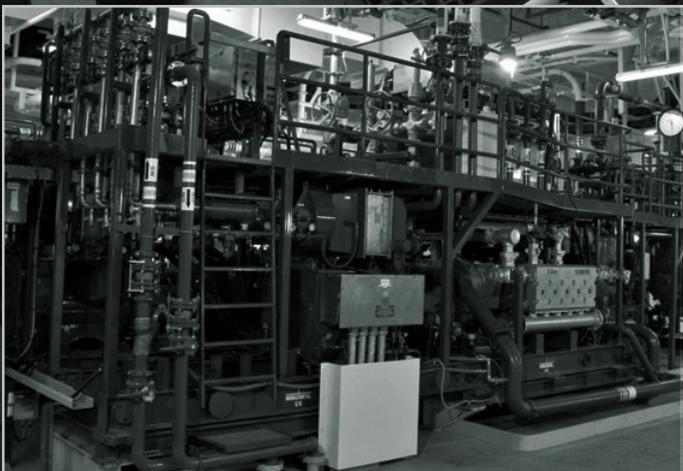


EnsurSet cement system

The EnsurSet™ cement system provides a durable cement sheath to help ensure well integrity and zonal isolation for the life of the well. Because of changes in pressure and temperature to the cement sheath over the life of the well, the cement sheath may fail or crack and allow annular pressure to build up.

Baker Hughes EnsurSet cement system helps address these problems. The self-sealing cement swells in the presence of hydrocarbons to shut off flow through the cement matrix and micro-annulus, mitigating the risks associated with sustained casing pressure and reducing and/or eliminating remedial operations.

- Shuts off liquid hydrocarbons and/or condensates flow through the cement matrix or micro-annulus
- Improves ductility of cement, making cement more resilient to stress, and improving its durability
- Provides better and easier mixing than hydrophobic materials
- Unique in-house apparatus created to validate the EnsurSet self-sealing properties under wellbore conditions
- Continuously seals over the life of the well



Seahawk offshore cementing unit

The Seahawk dual skid-mounted offshore cementing and well control unit accurately maintains precise slurry density control and consistency over a wide range of performance requirements in deepwater wells and other harsh environments. The unit includes an integral precision slurry mixing system along with the latest control and monitoring systems, facilitating precise control over job parameters, real-time job data acquisition, and post-job analysis. The Seahawk unit offers improved reliability and reduced nonproductive time due to 100% redundancy in pumping systems, and an optional dual mixer provides 100% redundancy in mixing systems.

- Custom engineered for any rig
- Pump plunger sizes can be quickly changed on-site for different pumping conditions
- Full redundancy available in all mixing and pumping systems
- Singapore-based installation team will quickly plan, mobilize, and install in any location worldwide
- Unit can be disassembled to fit through openings as small as 5 ft by 7 ft (1.52 m by 2.13 m)
- High-horsepower, high-pressure models available for special applications (up to 3,450 bhp and 20,000 psi [137.90 mPa])
- Real-time and remote-operation capabilities, controls, and diagnostics of offshore cementing units

When cost-effective, efficient zonal isolation is key, the **Seahawk Lite efficiency cementing unit** offers a dual, skid-mounted offshore cementing and well control unit designed just for that. Like its predecessor, the Seahawk Lite unit also includes an integral precision slurry mixing system that accurately maintains slurry density and consistency over a wide range of performance requirements. It can also be equipped with the latest control and monitoring systems for precise control of job parameters, real-time job data acquisition, and post-job analysis. However, this unit is available on an 8 ft (2.4 m) wide skid, configured for limited floor space. The unit's modular design simplifies installation on offshore drilling equipment and provides greater application versatility.

- Gross weight is 8% lower and areal footprint is 20% smaller than a conventional Seahawk cementing unit. Also, fewer connections are required, all of which result in more efficient and safer installation.
- Equipped with two high-pressure pumps and two 10-bbl (1.6 m³) stainless steel displacement tank compartments
- De-aerating mixer contains 7-bbl (1.1 m³) mixing tank and a hydraulically driven recirculating pump
- Options include: subzero temperature features, automatic liquid additive system for uniform chemical mixing, remote radiator cooling package designed for continuous operation at 115°F (46°C) ambient temperature, seawater cooling package



Hawk cementing unit

The self-contained, trailer-mounted Hawk cement mixing and pumping unit includes an integral precision slurry mixing system that accurately maintains slurry density and consistency over a wide range of performance requirements. It is also equipped with the latest Baker Hughes control and monitoring systems for precise control of job parameters, real-time job data acquisition, and post-job analysis.

To ensure successful completion of a job in the event of a component failure, backup systems are provided for the hydraulic system, electronic system, and drive train.

- Delivers enhanced quality control with auto cement control (ACC) system
- Permits lightweight cement mixing capabilities
- Incorporates redundant systems for enhanced wellsite reliability



